DIET and DIABETES

T.C. RAGHURAM
SWARAN PASRICHA
R.D.SHARMA

NATIONAL INSTITUTE OF NUTRITION
HYDERABAD-500 007, INDIA

Community Health Cell
Library and Documentation Unit
367, "Srinivasa Nilaya"
Jakkasandra 1st Main,
1st Block, Koramangala,
BANGALORE-560 034.
Phone : 5531518

DIET and DIABETES

T.C. RAGHURAM

SWARAN PASRICHA

R.D. SHARMA

NATIONAL INSTITUTE OF NUTRITION
Indian Council of Medical Research
HYDERABAD - 500 007 : INDIA

First Edition ... 1991
Second Edition ... 1993
Reprinted ... 1997

Acknowledgements

The authors thank

Dr. K. T. Achaya
Dr. Kamala Krishnaswamy
Dr. B.K. Sahay
Dr. P. Shyamsunder
Dr. K. Vijayaraghavan

for their valuable suggestions in the preparation of this book.

Price : Rs.18-00

DS-300
093
04791

COMMUNITY HEALTH CELL
LIBRARY
AND
DOCUMENTATION
UNIT

Printed by National Institute of Nutrition at their Offset Press.

FOREWORD

Diabetes mellitus, a complex metabolic disorder, has been associated with diet for centuries. The science of nutrition has greater application in diabetes than in several other clinical disorders.

The National Institute of Nutrition has been carrying out studies on various nutrition problems and metabolic diseases with the aim of finding simple remedies that can be easily adopted by the affected population. The use of fenugreek (methi) seeds in diabetes is one such simple remedy to control blood sugar levels. The beneficial effects of fenugreek in diabetes have been established by studies in experimental animals and human subjects. Several recipes based on fenugreek seeds are given in this book for use by diabetics.

This book is written primarily to convey to the public new information concerning the role of diet in diabetes and how it can help in control of the disease. It is well recognised that scientific research will be meaningful only if the fruits of research are conveyed to the needy population. The publication of this book is in line with the Institute's continuous endeavour to disseminate knowledge of nutrition among the general population. Although the main emphasis is on diet, other aspects like exercise and drugs which are equally important in the management of diabetes are discussed in this book.

I am happy to note that the first edition of this book was popular among diabetic patients and dietitians, and all the copies have been sold out within a year of its publication. The second edition has been revised by the authors taking into consideration the views of various readers. I am sure that this handbook would continue to be useful in formulating dietary guidelines for the management of diabetes.

Dr. Vinodini Reddy
Director

Hyderabad,
1-6-1993

CONTENTS

	Page No.
INTRODUCTION	
Types of Diabetes	1
Risk Factors	3
Prevalence	3
Symptoms	4
Diagnosis	5
Complications	7
Prevention	10
MANAGEMENT OF DIABETES	
DIET	11
Calories	11
Carbohydrates	14
Proteins	15
Fats	16
Vitamins/Minerals	17
Fibre	17
Fenugreek Seeds	19
Dietary Guidelines	20
Food Exchange System	22
Glycemic Index	22
Model Diets	23
Alcohol	25
Artificial Sweeteners	26
EXERCISE	26
DRUGS	27
Insulin	27
Oral Drugs	27
EDUCATION	29
APPENDIX	31
1. Fenugreek Recipes	31
2. Food Exchange System	40
3. Diabetic Diets	46

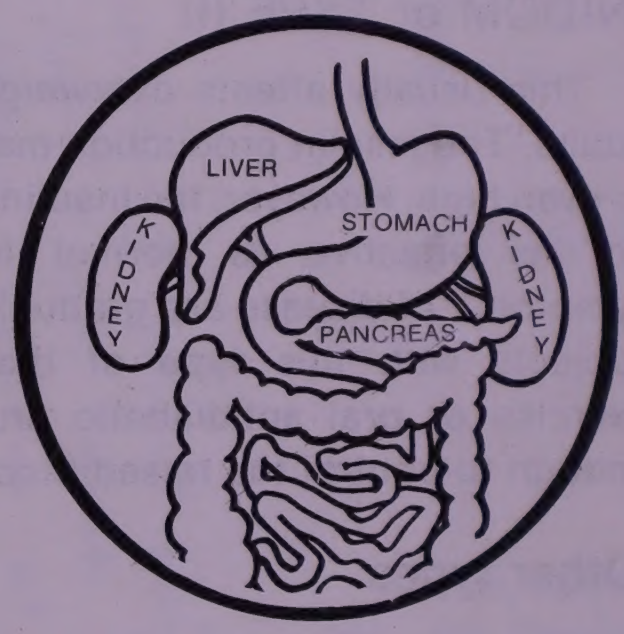
4. Nutritive Value of Common Foods and Preparations and Average Weight of Foods 54
5. Common Household Measures 60

BIBLIOGRAPHY 62

Diabetes mellitus or 'madhumeham' has been known for centuries as a disease related to sweetness. Persons with diabetes have too much sugar in blood and urine. However, there is no need to worry, since diabetes can be kept under control with certain changes in the life style - food intake, exercise and regular intake of prescribed medicines. Even though more than 30 million people all over the world are affected with diabetes not all are well informed about the nature of their disease.

What Diabetes is

We require energy for all our daily activities. This energy is mainly derived from carbohydrates. When we eat carbohydrates through our diet, our blood sugar increases. If it rises beyond 180 mg/100 ml, sugar is excreted in the urine. Normally, insulin, a hormone produced by the beta-cells of the pancreas, helps to utilise sugar for the production of energy by the body. It helps in glucose uptake by the cells, prevents a rise in blood sugar and maintains its level within certain normal limits. In diabetes, either the pancreas cannot produce enough insulin or what is produced is not effective in controlling the blood sugar. Lack of effective insulin results in inadequate utilisation and consequent rise in blood sugar. This affects the metabolism of several nutrients, with varying ill-effects. However, with modern management, patients can remain symptom free and maintain good health.



IN DIABETES, THERE IS TOO MUCH SUGAR IN BLOOD AND URINE DUE TO LACK OF EFFECTIVE INSULIN. DIABETICS CAN LEAD A NORMAL LIFE PROVIDED THEY MAKE CERTAIN CHANGES IN THEIR LIFESTYLE, PARTICULARLY IN THEIR DIET.

Types of Diabetes

Mainly there are two types of diabetes :

1. Insulin-dependent diabetes mellitus.
2. Non-insulin dependent diabetes mellitus.

Insulin-dependent diabetes (IDDM or TYPE I)

Usually, this type of diabetes affects children or adolescents. There is little or no production of insulin and as a result, such individuals require daily insulin injections. It is rapid in onset. The symptoms get severe, when insulin injections are discontinued. The diabetic develops a life-threatening metabolic complication referred to as ketoacidosis.

Non-Insulin dependent diabetes (NIDDM or TYPE II)

This usually affects overweight or obese adults. The insulin production may be normal or even high. However, the insulin produced is not as effective as normal insulin. The symptoms of disease are gradual in onset. In subjects with this type of diabetes, diet, exercise or oral antidiabetic drugs may be enough to control the raised blood sugar.

Other types

Recently, a third type of *malnutrition-related diabetes mellitus* (MRDM) has been categorised as a separate entity. This type of diabetes is mainly seen in some tropical countries like India, and it occurs in young people between 15-30 years of age. Generally, people with MRDM are lean and undernourished. In this type of diabetes, the pancreas fails to produce adequate insulin. As a result, these diabetics require insulin. In contrast to type I diabetics, these patients generally do not develop ketoacidosis, when insulin injections are discontinued.

In a few subjects secondary diabetes may result from other hormonal disorders.

Impaired glucose tolerance (IGT)

When the glycaemic response (rise in blood glucose) after the administration of a 75 g of oral glucose load is intermediate between normal and diabetic, that condition is described as impaired glucose tolerance. Individuals with impaired glucose tolerance are generally free from symptoms of diabetes. However, they have the potential to develop diabetes at a later stage; they should be more careful in their diet and avoid obesity. In addition, they should undertake regular exercise.

Gestational Diabetes

Diabetes developed during pregnancy is described as gestational diabetes. It occurs in about 1% of pregnant women.Gestational diabetes increases the diabetes related complications during pregnancy, and also the subsequent development of real diabetes after the delivery. Pregnant women who have family hisotry of diabetes or bad obstetric history should be screened for gestational diabetes employing the glucose load test.

PREGNANT WOMEN SHOULD UNDERGO CHECK-UP FOR DIABETES

Risk Factors

Although the actual cause is not clear, the following factors have been shown to increase the risk for diabetes :

* Hereditary factor
* Obesity
* Sedentary life
* Aging

It is a general observation that diabetes, particularly of the NIDDM type, seems to run in families. However, hereditary predisposition alone is not enough. Several factors such as diet, obesity, ethnic background, aging etc., have all been shown to influence the development of diabetes. In addition, in Type I diabetes, auto-immunity (destruction of the beta cells of the pancreas due to antibodies produced in the body) and viral infections may play a role.

People who eat too much food and lead a sedentary life become overweight and obese. Obesity reduces the sensitivity of tissues to the action of insulin in the utilization of glucose. Lack of physical exercise and obesity increase the risk for development of diabetes in the later stage of a person's life. Thus, obesity, a sedentary life and aging are also considered as risk factors for diabetes.

Prevalence

It is generally believed that diabetes is more prevalent in affluent societies where obesity is a major health problem. However, it has been observed that undernourished subjects are equally susceptible to diabetes. In India, 2-4% of the population are affected with diabetes, and more than 90% of all diabetics belong to the non-insulin dependent type.

SYMPTOMS OF DIABETES

* Excessive thirst (Polydypsia)
* Increased appetite (Polyphagia)

* Frequent urination (Polyuria)

* Loss of weight

* Easy tiredness

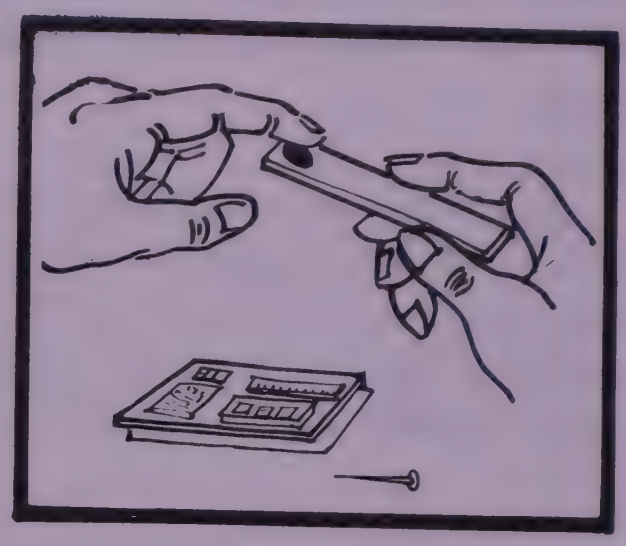
* Slow healing of cuts and wounds.

Symptoms

Many diabetics may not be aware that they have the disease. Quite often they come to know of it only during a routine medical checkup. The following symptoms in an otherwise healthy person should make him suspect that he may have diabetes.

Diagnosis

One may suspect diabetes when sugar is present in the urine or when the blood sugar after fasting or two hours after normal meals is higher than 120 mg/100 ml. However, the diagnosis of diabetes is confirmed by conducting an oral glucose tolerance test.



Oral Glucose Tolerance Test (OGTT)

This test is carried out after 12 hours of overnight fasting. Glucose - 75 g in adults and 1.75 g/kg of body weight in children is orally administered. Before the glucose load and two hours after it, blood samples are collected and glucose levels are estimated.

The diagnostic criteria for diabetes and impaired glucose tolerance test (IGT) are given in Table 1. Generally, in normal persons without diabetes or impaired glucose tolerance, the fasting blood sugar levels vary between 80-110 mg/100 ml. The blood sugar levels increase after the glucose load and come down to basal level within two hours.

Table - 1

DIAGNOSTIC CRITERIA FOR IGT AND DIABETES

	Blood sugar levels (mg/dl)	
	IGT	**Diabetes**
Fasting	< 120	$\geqslant 120$
2 hours after 75 g glucose load	120 - 180	$\geqslant 180$

$<$ Stands for 'less than'

$\geqslant$ Stands for 'equal to or more than'

Urinary Sugar

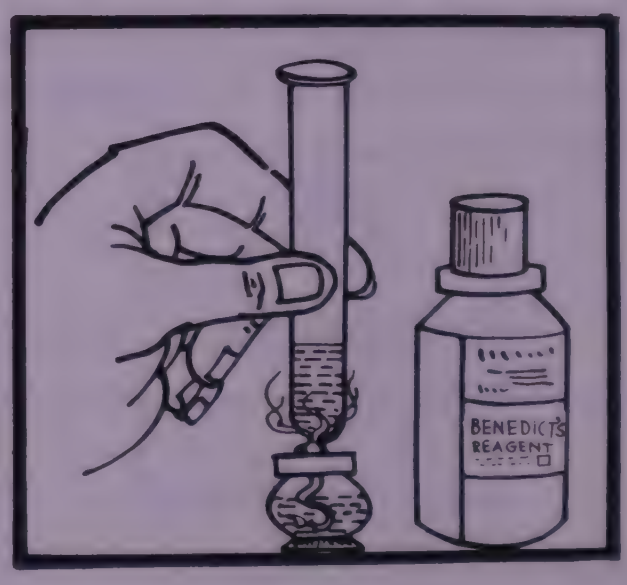
Generally, glucose is excreted into the urine when the blood glucose levels are elevated beyond 180 mg/100 ml. However, in a few subjects, due to lower limit of renal threshold, even when the blood glucose levels are lower than 180 mg/100 ml, glucose can be excreted in the urine. This condition is described as renal glycosuria.

Apart from glucose, other reducing sugars such as lactose (in lactating women) which are unrelated to diabetes, can give rise to false positive results with Benedict's test. Therefore, values of blood glucose are more reliable than urinary sugar.

Diabetics lose varying amounts of glucose depending on the severity of disease and the dietary intake of carbohydrates. The approximate amount of urinary sugar can easily be monitored by the simple Benedict's test or by using commercially available diagnostic strips (Uristix). The changes in the colour of the reagent or strip indicate sugar levels in the urine.

Benedict's Test

Eight drops of urine and 5 ml of Benedict's solution are taken in a test tube and mixed. The test tube is kept in boiling water for 5 minutes and colour is noted.



It is better to carry out this test on the second urine sample collected in the morning. Urinary sugar in this sample will more or less reflect the blood sugar level. Self-monitoring of urinary sugar at frequent intervals provides valuable information to the patient as well as to the doctor in fixing the required dose of drug to control blood sugar. During acute infections, or when blood sugar is fluctuating widely during antidiabetic therapy, the urinary sugar must be monitored once or twice daily.

DIABETICS SHOULD CHECK THEIR URINARY SUGAR AT REGULAR INTERVALS

Table - 2

INTERPRETATION OF BENEDICT'S TEST

Colour	Report	Approximate Sugar in Urine g%	Blood mg%
Green discolouration	0 to trace	-	< 200
Green precipitate	+	0.25	200 - 250
Greenish-yellow precipitate		0.5	250 - 300
Yellowish-orange precipitate	+++	1.0	300 - 350
Brick-red precipitate	++++	>2.0	> 350

Glycosylated hemoglobin

As the concentration of glucose in blood rises, more of it gets attached to hemoglobin (a pigment present in RBC) and the combined molecule is chemically estimated as glycosylated hemoglobin. It reflects the general trend of glucose levels in the blood during the previous 2-3 months. In a normal population, the glycosylated hemoglobin concentrations vary from 4-7%, while in diabetes it is in the range of 8-18% of the total hemoglobin depending on the blood sugar level.

Complications

Diabetics can develop acute as well as long-term complications.

Acute Complications

A diabetic is likely to develop acute complications as a result of sudden and severe decrease or increase in blood sugar levels.

1. Hypoglycemia

The rapid and severe lowering of blood sugar below certain critical normal limits (below 40-50 mg/dl) is known as hypoglycemia. The person with hypoglycemia or low blood sugar content experiences increased appetite, weakness, sweating, restlessness, palpitation and giddiness. This can result from an excessive dose of insulin with inadequate amount of carbohydrates in the diet, intake of alcohol along with antidiabetic drugs or following strenuous exercise.

THE DIABETIC WHO DEVELOPS HYPOGLYCEMIA SHOULD IMMEDIATELY BE GIVEN SUGAR OR GLUCOSE AND A DOCTOR SHOULD BE CONSULTED

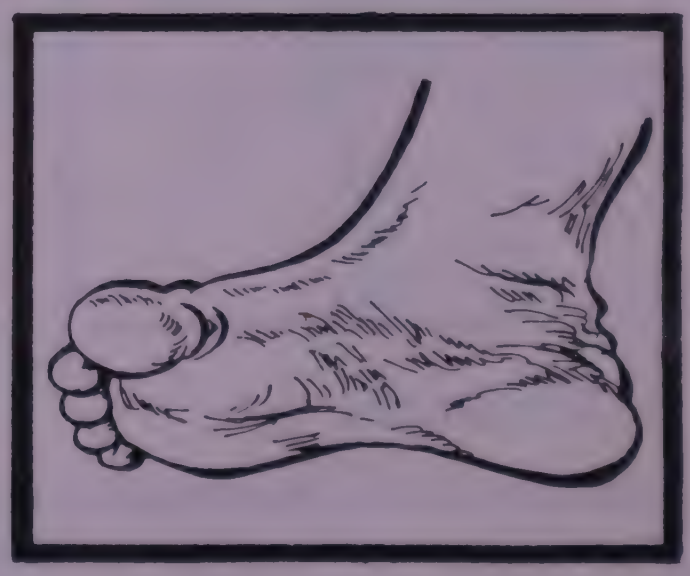
2. Ketoacidosis

When the body cannot utilise carbohydrates to provide energy, it burns increased amounts of fats and certain aminoacids. This results in increased formation of metabolic products known as ketones. When the ketones produced are more than what the body can handle, they accumulate in the blood resulting in ketoacidosis. This is a serious condition as the patient may go into coma. Initially the patient experiences intense thirst, weakness and drowsiness with or without vomiting. It may result from irregular or inadequate treatment of diabetes, particularly during stress and acute infections. In ketoacidosis, ketones (acetone) are present in the urine, which can be detected using commercially available strips (Ketodiastix).

WHEN KETOACIDOSIS IS SUSPECTED, THE PATIENT SHOULD BE IMMEDIATELY TAKEN TO A HOSPITAL.

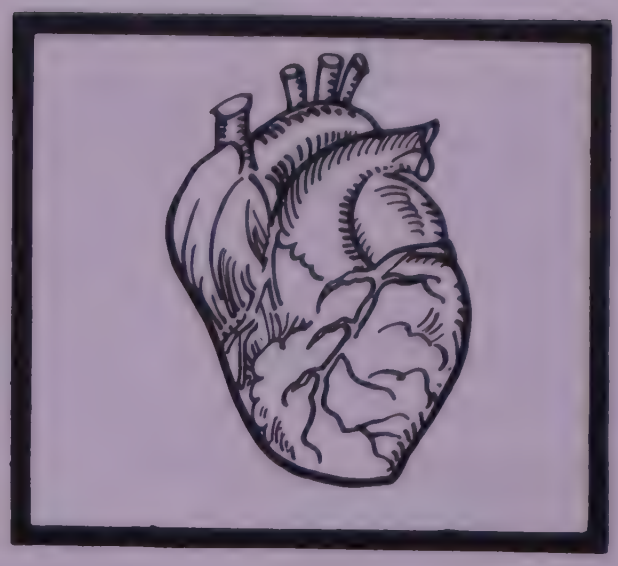
3. Infections

In diabetics, cuts and wounds heal slowly. They are prone to tuberculosis and infections of the skin, urinary tract and foot. In all such manifestations, the patients should promptly consult a doctor, who will control diabetes and treat the infections with appropriate antibiotics.



DIABETICS SHOULD TAKE SPECIAL PRECAUTIONS TO PREVENT INFECTIONS OF THE SKIN AND FOOT.

Long-term Complications



Diabetics are predisposed to two types of complications of long duration. One relates to the increased predisposition of the diabetic for atherosclerosis (hardening of blood vessels due to deposition of fatty substances), because, they generally have high levels of blood lipids, such as cholesterol and triglycerides, which make them susceptible to heart disease and stroke.

Serum Cholesterol

Increased cholesterol levels have been recognised as a risk factor for coronary heart disease. It is recommended that serum cholesterol should be measured in all adult diabetics once in two years, and in all normals of over 20 years of age at least once in five years.

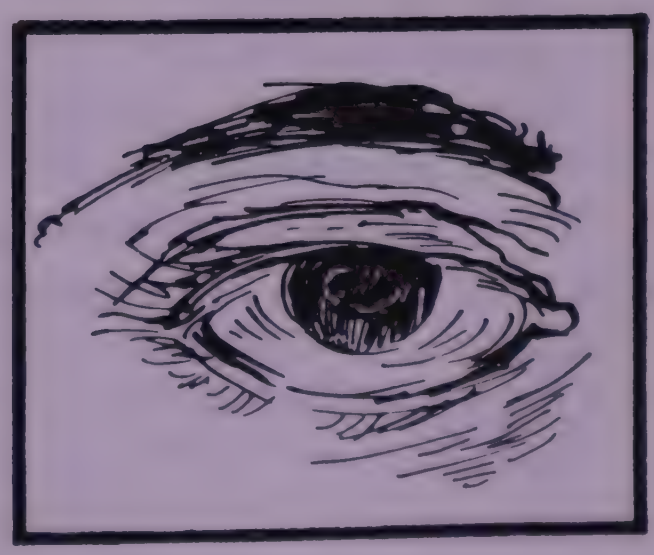
The following normal limits for cholesterol levels have been proposed :

Table - 3

SERUM CHOLESTEROL LEVELS

Cholesterol Level	Serum Cholesterol (mg/100 ml)
Desirable	< 200
Borderline - high	200 - 239
High	> 240

Source : National Cholesterol Education Programme, Arch. Intern. Med., 148:36, 1988.



Cholesterol levels in blood can be reduced by changing the dietary pattern or by taking drugs. Control of diabetes also lowers cholesterol. Depending on the level of cholesterol, the doctor decides on dietary or drug treatment or both for lowering the level.

The second type of long-term complications are lesions that affect the small blood vessels (microangiopathy) of the eyes

and kidneys. Lesions of the eye (retinopathy) results in rapid deterioration of eyesight. Lesions of the kidney (nephropathy) result in the excretion of protein in the urine. Neglect may lead to kidney failure. Diabetics can develop lesions of the peripheral nervous system (neuropathy). Patients with neuropathy experience tingling, numbness and a burning sensation in the distal parts of the upper and lower limbs.

DIABETICS SHOULD MAINTAIN BLOOD SUGAR AND LIPID LEVELS WITHIN NORMAL LIMITS TO PREVENT ACUTE AND LONG-TERM COMPLICATIONS.

Prevention

Environmental factors play a major role in the incidence of NIDDM in those with family history of diabetes. As we have no control on the selection of our ancestors, we can at least take suitable steps to prevent non-insulin dependent diabetes. Lack of physical activity and higher intake of fatty foods result in obesity which in turn increase the incidence of diabetes. Therefore, every effort should be made to prevent obesity with dietary control and regular exercise.

Management of Diabetes

Although it is not possible to cure diabetes completely, diabetics can lead almost a normal life if they follow certain do's and don'ts scrupulously. Cooperation of the patient is very important in the management of diabetes.

Objectives in the management of diabetes are to :

* Reduce the sugar in blood and urine
* Maintain ideal body weight
* Treat the symptoms
* Reduce serum lipids
* Provide adequate nutrition
* Avoid acute complications
* Prevent vascular complications

The main modes of treatment of diabetes are :

* Diet
* Exercise
* Drugs
* Education

DIET IN DIABETES

Diabetic diet need not be a complete deviation from the normal diet. The nutritional requirements of a diabetic are the same as in the non-diabetic. Normal Indian diets are generally high in carbohydrate and low in fat, with carbohydrates providing 60-65% and fat providing 15-25% of total calories. The rest is derived from proteins. Thus even a normal Indian diet is ideal for a diabetic. However, the nutrient intake has to be tailor-made to the individual based on the age, sex, weight, height, physical activity and physiological needs of the patient. It is always better to consult a dietitian to prescribe and formulate a suitable individual diet.

BOTH DOCTOR AND DIETITIAN HAVE A ROLE IN THE DIETARY MANAGEMENT OF DIABETES

Dietary Prescription

Details regarding the patient's day-to-day activity including his/her current dietary history are first collected before preparing the dietary prescription. Based on the nature of physical activity, body weight and dietary history, the total daily requirements of calories are calculated.

Calories

The calculated calorie requirement should allow the patient to lose or gain weight as required and maintain body weight 10% lower than the ideal/desirable body weight.

How to calculate the ideal body weight

Ideal body weight (in kg) can be simply calculated for an individual by subtracting 100 from his/her height (in cms). For example, ideal body weight of a person with 160 cm height is 60 kgs (160-100). It is always better for a diabetic to maintain the body weight 10% lower than the ideal body weight.

The ideal body weight will show whether the person is overweight (20% above his ideal body weight) or underweight (20% below the ideal body weight). Based on these, the daily calorie requirements of an individual per kg body weight can be worked out as indicated below.

This calorie intake is intended for a person who does sedentary work. For persons engaged in greater physical activity, the recommended calorie intake may be increased as per the needs. A person above the age of 50 years of age requires 10% less calories for each decade. If the disease is mild, a diet restricted in calories

THE RECOMMENDED CALORIE INTAKE FOR DIABETIC BASED ON BODY WEIGHT

Overweight
20 Kcal/kg. wt/day

Ideal weight
30 Kcal/kg. wt/day

Underweight
40 Kcal/kg. wt/day

Table - 4
RECOMMENDED DIETARY ALLOWANCES FOR INDIANS

Group	Body Wt. (kg)	Particulars	Energy (Kcal/d)	Proteins (g/d)	Fats (g/d)
Men	60	Sedentary	2425		
		Moderate	2875	60	20
		Heavy	3800		
Women	50	Sedentary	1875		
		Moderate	2225	50	20
		Heavy	2925		
		Pregnant	+300	+15	30
		Lactating			
		0- 6 months	+550	+25	45
		6-12 months	+400	+18	45
Boys	35.4	10-12 years	2190	54	22
Girls	31.5	10-12 years	1970	57	22

Source : Nutrient Requirements and Recommended Dietary Allowances for Indians, Indian Council of Medical Research, 1989.

and devoid of refined sugars such as sweets, jam and jellies, is adequate. The Recommended Dietary Allowances for normal Indian is given in Table 4. Generally calories recommended for diabetics are lower as compared to normals.

Pregnant Women

Pregnant women with diabetes are more prone to certain illnesses than non-diabetic women. Insulin requirements goes up one to three times in pregnancy. In the absence of adequate insulin, glucose cannot be utilised and instead fat is used as fuel, resulting in ketoacidosis. Pregnant women should be screened for ketones in the urine. In addition to ketoacidosis, pregnant women with diabetes are more prone to preeclampsia, toxaemia, urinary tract infections and hydromnios.

Uncontrolled diabetes during the first three months of pregnancy increases the risk of abortions and congenital malformations in the foetus. Elevated blood sugar should therefore be adequately controlled by dietary means and treatment with insulin even before conception. Delivery should be conducted under medical supervision.

Neonatal hypoglycaemia and respiratory distress are common in the newborn of a diabetic mother. The new born is typically heavier than infants born to non-diabetic mothers. Although the newborn is heavier than normal, it is premature in development and functional capacity. Thus the neonate of a diabetic mother requires special attention after birth.

Pregnant woman has to eat not only to meet her physiological needs, but also to meet the requirements of her growing foetus. During pregnancy, the diabetic should be given 30-35 Kcal/kg of the desirable body weight. The diet should provide 1.5 - 2.5 g of protein/kg body weight. The total gain in body weight during pregnancy should ideally not exceed 12 kg.

BLOOD SUGAR SHOULD BE KEPT WITHIN NORMAL LIMITS THROUGHOUT PREGNANCY TO PREVENT DIABETES-RELATED COMPLICATIONS IN THE MOTHER AND NEWBORN.

Children

Nutrient requirements of children relative to their body weight are generally higher than those of adults to take care of their growth and developmental needs. Children suffering from Type I diabetes require the normal diet recommended for their age group (Table 4). It can also be calculated based on their age. Calorie

requirements for children are 1000 basal calories plus 125 calories for boys and 100 calories for girls for every year of age upto 12 years. For example, a 10 year old boy requires 2250 Kcal (1000 basal + 1250 for 10 years).

Distribution of nutrients in the total calories

The total daily intake of calories from carbohydrates, proteins and fats in the diet for a diabetic should be distributed in the following way :

Distribution of Calories

	% of total calories
Carbohydrate	60-65
Protein	15-20
Fat	15-25

Carbohydrates

Our diet consists mainly of carbohydrates. One gram of carbohydrate provides 4 Kcals. of energy. Generally, in Indian diets, carbohydrates provide 60-70% of the total calories. Diabetics need not restrict the carbohydrate intake, but they can alter the type of carbohydrate in their diet. Cereals and pulses contain complex carbohydrates, which are broken down into simple sugars before they are absorbed from the gut. On the other hand, sugar, honey, jaggery and jam contain simple sugars which are directly absorbed. They are referred to as *refined carbohydrates and are not recommended for diabetics,* as they cause a rapid rise in blood sugar, which certain complex carbohydrates do not.

Sugars present in fruits and milk raise the blood sugar at a slightly slower rate. Fruits can be taken in the right quantity. *It is recommended that a diabetic derive 60-70% of calories from carbohydrates of the desirable kind.*

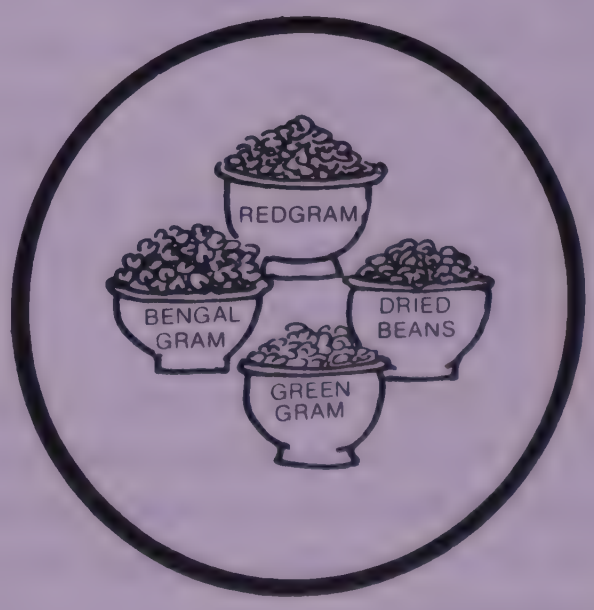
Distribution of carbohydrates in the diet

Since the blood sugar level depends mainly on the intake of carbohydrates, it is important to distribute the intake of carbohydrates in accordance with daily needs. The total amount of carbohydrates can conveniently be divided into 4-5 equal parts. One-third (33%) of the diet is served during lunch and another one third (33%) during dinner. Of the remaining one third, 25% is served during breakfast and the rest (9%) during evening tea or at bedtime. In insulin-dependent diabetics, it may be necessary to give additional carbohydrates before the patient goes to sleep to prevent hypoglycemia if the patient is on slow-acting insulin. Individuals who take a heavy breakfast and dinner, and only snacks during lunch, must modify the dietary guidelines accordingly.

DISTRIBUTION OF CARBOHYDRATES IN THE FOOD SHOULD BE TAILOR-MADE TO INDIVIDUAL HABITS.

Proteins

Proteins are essential for growth, development and tissue repair. When needed, proteins also provide energy in the body. One gram of protein provides 4 Kcal of energy. Proteins taken in the diet are broken down into amino acids before absorption into the blood. The Recommended Dietary Allowance (RDA) for protein is 1.0 g/kg. body weight (Table 4). Children, pregnant and lactating women require more than this ratio of protein for growth and development and other physiological needs. In addition, the requirement of protein goes up in conditions such as trauma and burns. Meat and meat products, pulses, legumes and nuts are all rich sources of protein. In diabetics with associated renal problems, protein is restricted to 0.6 g/kg body weight. However, this should be of high biological value, such as in an egg and milk.



It is generally recommended that 15-20% of total calories be derived from proteins. In insulin-dependent diabetic children, 1-1.5 g of protein/kg body weight is recommended.

PROTEINS FROM VEGETABLE SOURCES ARE BETTER THAN FROM ANIMAL SOURCES AS THEY DO NOT CONTAIN CHOLESTEROL AND ALSO ADD ROUGHAGE (FIBRE) TO THE DIET.

Fats

Fats are concentrated sources of energy. One gram of fat yields 9 Kcal. Excess intake of fat thus increases body fat and leads to obesity. Fats contain essential fatty acids, and are also vehicles for fat-soluble vitamins such as vitamin A, D, E and K.

There are *three types of fats.* Ghee, butter, vanaspati and coconut oil contain a high proportion of *saturated fats* which are likely to increase the serum cholesterol. They should be taken in small quantities. Vegetable fats, such as sunflower and safflower oil, contain *polyunsaturated fatty acids* (PUFA) which are considered good for health. *Monounsaturated fatty acids*, present in groundnut, palm oil and olive oil are not harmful to the body. Fats from above mentioned dietary sources are described as visible fats. We also get fats from cereals, pulses, milk and milk products, eggs, flesh foods and nuts and they are considered as invisible fats.

Both the total quantity, as well as the type of fat influence the serum lipids and could increase the risk for heart diseases. Since serum lipids are generally raised in diabetes, diabetics have to be careful with the amount and nature of fat they consume. Non-vegetarian diabetics can consume fish or chicken without the skin, instead of egg, mutton, liver and brain which are high in cholesterol. Fatty acids present in fish are particularly helpful.

It is recommended that 15-25% of the total calories can be derived from fat. The saturated, mono and poly unsaturated fats can each provide approximately equal proportions of total calories. *Diabetics can take 20 g visible fat/day.* Persons with high serum lipids or obesity should restrict their fat consumption particularly of saturated fats.

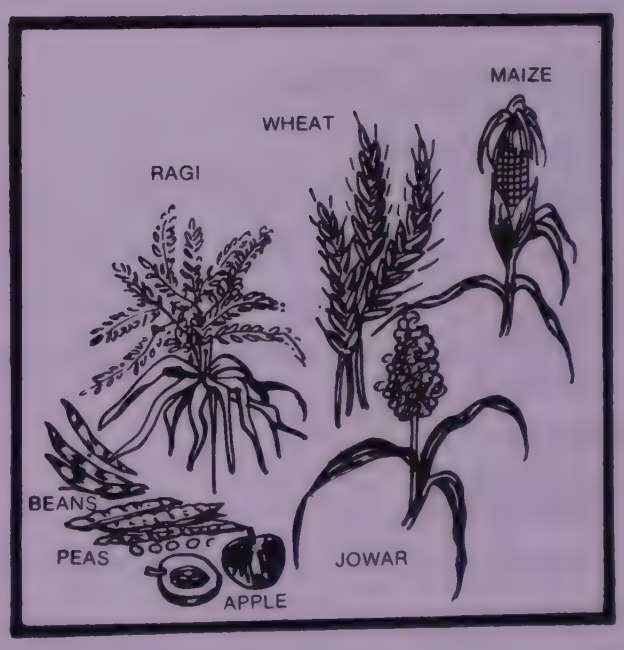
FATS FROM VEGETABLE SOURCES ARE BETTER THAN THOSE FROM ANIMAL SOURCES.

Vitamins and Minerals

These are protective factors which in small amounts are essential for the body. They are found in green leafy vegetables, fresh fruits, milk and dairy products, cereals, nuts, fish and egg. Daily intake of these foods can provide enough vitamins and minerals.

DIABETICS, DURING INFECTIONS AND OTHER COMPLICATIONS, MAY REQUIRE HIGHER AMOUNTS OF VITAMINS AND MINERALS IN THE FORM OF SUPPLEMENTS.

Dietary Fibre



Dietary fibre is that part of food that is not digested by the gut and is considered as unavailable carbohydrate. It is not a single entity, but consists of a wide range of complex carbohydrates. Fibre present in vegetables, fruits, legumes and fenugreek seed is soluble in nature and more effective in controlling blood sugar and serum lipids than the insoluble fibre present in cereals and millets. However, long-term consumption of insoluble fibre also improves glucose tolerance.

Diets containing high dietary fibre can reduce blood sugar, serum cholesterol and relieve constipation. In addition, dietary fibre is beneficial in the prevention and treatment of several diseases such as cardiovascular diseases and colon cancer. Excess dietary fibre may cause gastrointestinal symptoms such as flatulence (gas formation) and diarrhoea. It may also interfere with the absorption of minerals such as iron, calcium and zinc. Intake of 25 g of dietary fibre per 1000 calories is considered to be optimum for a diabetic. High-fibre foods have a low caloric value and low glycaemic index, and therefore diabetics should consume such foods liberally.

The dietary fibre content of some common Indian foods is given in Table 5.

Table - 5

DIETARY FIBRE CONTENT OF SOME COMMON INDIAN FOODS

Food	Dietary Fibre (g/100 g)
Cereals and Millets	
Rice	7.6
Wheat	17.6
Sorghum	14.3
Bajra	20.3
Ragi	18.6
Pulses and Legumes	
Green gram dhal	13.5
Black gram dhal	14.3
Red gram dhal	14.1
Bengal gram dhal	13.6
Nuts and Oilseeds	
Groundnut	6.1
Coconut dry (copra)	8.9
Roots and Tubers	
Sweet potato	7.3
Potato	4.0
Yam	5.3
Fruits	
Banana	2.5
Mango	2.3
Vegetables	
Amaranth	3.4
Palak	5.0
Brinjal	2.0
Ridge gourd	5.7
Snake gourd	1.8
Bottle gourd	2.8
Yellow pumpkin	0.5

Source : B.S. Narasinga Rao, Nutrition Foundation of India Bulletin, 9 : (4),1988.

Fenugreek Seeds

Fenugreek *(Trigonella foenum graecum)* is a common herb (Sanskrit - Mathika; Hindi and Gujarati - Methi, Telugu - Mentikoora, Malayalam - Uluba). Its seeds are commonly used as a condiment for seasoning in Indian homes. The medicinal qualities of fenugreek seeds are known since ancient times and have been described in Greek, Latin and Ayurvedic literature. It is reported that a decoction of fenugreek seeds suppresses the urinary excretion of sugar and relieves symptoms of diabetes.

Seeds of fenugreek are a rich source of fibre. It contains mucilaginous fibre and total fibre to the extent of 20% and 50% respectively. In addition, it also contains trigonelline - an alkaloid, known to reduce blood sugar level. Studies in humans and experimental animals conducted at the National Institute of Nutrition, Hyderabad, and in other countries have shown the beneficial effects of fenugreek seeds. *Fenugreek leaves do not show such effects.*

Fenugreek seed powder in the diet reduces blood sugar and urine sugar with concomitant improvement in glucose tolerance and diabetic symptoms in both non-insulin dependent and insulin dependent diabetic patients. It also lowers the levels of serum lipids such as cholesterol and triglyceride. Thus fenugreek seeds have an overall beneficial effect in diabetes.

Use of fenugreek seeds in the management of diabetes

The quantity of fenugreek seeds to be taken daily depends upon the severity of diabetes. The doses vary from 25 g to 50 g. To begin with, 25 g of fenugreek seeds may be taken in two equal doses of 12.5 g each (approximately two teaspoons) along with lunch and dinner. The seeds can be taken as such after overnight soaking in water or in powder form as a drink in water or butter milk, 15 minutes before the meal. The fenugreek seed powder can be incorporated in preparations such as chapati, rice, dhal and vegetables. The preparations can be made salty or sour according to individual taste. The bitter taste of the seeds is a drawback, and preparations containing fenugreek seeds have been developed at the National Institute of Nutrition, Hyderabad, in which bitter taste of the seeds could be masked by the taste of other ingredients.

Fenugreek recipes

Fourteen recipes are described in Appendix I each containing 12.5 g of fenugreek seeds. Any two of the preparations can be included in a day's menu so that the diabetic receives the effective dose (25 g/day) of fenugreek seeds. All the preparations have proved palatable and acceptable to volunteers. Incorporation of fenugreek seeds reduced the glycaemic index of the preparations by 10 to 20%.

Precautions

1. *Fenugreek preparations are only useful as supportive therapy and the usual antidiabetic treatment employed should be continued.* However, it has been observed that the requirement of antidiabetic drugs decreases with the use of fenugreek. Optimal dose of antidiabetic drugs required by a diabetic should be decided on the advice of a physician. *During acute complications of diabetes immediate medical advice should be sought.*
2. Fenugreek recipes can be taken by diabetic patients as long as high blood sugar and urine sugar levels persist.
3. The dietary caloric intake particularly from saturated fats and simple sugars should be restricted and body weight should not be allowed to increase. In addition to the use of fenugreek seeds, regular physical exercise such as walking is beneficial.
4. A few patients initially may develop diarrhoea or excess flatulence (gas formation) on consumption of fenugreek. If they continue to have these problems, they can reduce the amount of fenugreek.
5. Sugar should be avoided.

Dietary Guidelines

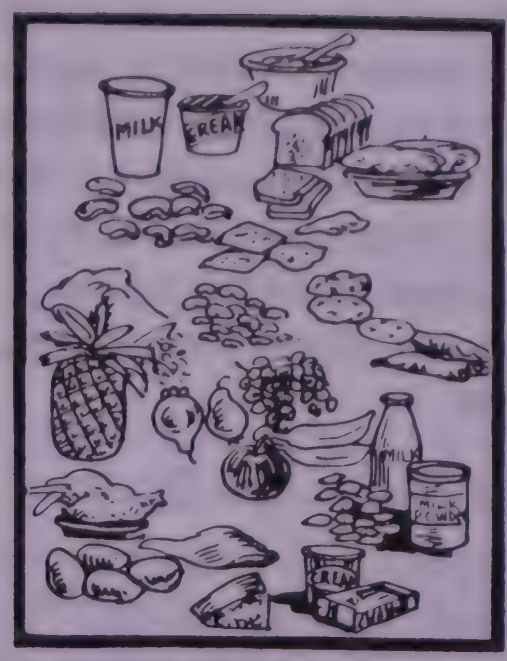
In general, all foods can be classified into the following 3 categories for diabetics :

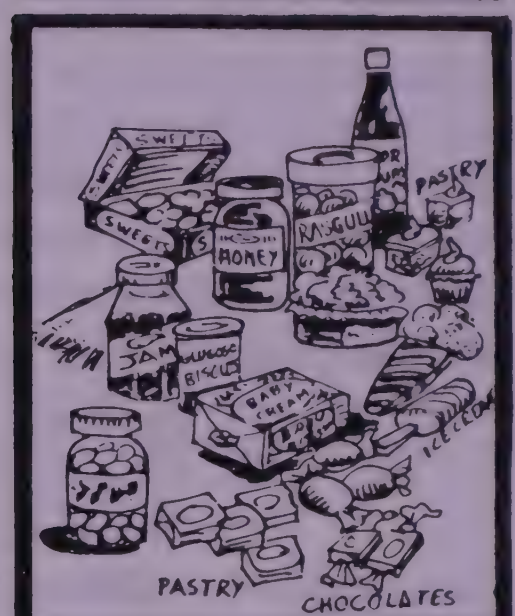
1. Foods that can be used freely
   * Vegetables
   * Green leafy vegetables
   * Spices
   * High-fibre foods

2. Foods to be used in moderate amounts
   * Fats
   * Nuts
   * Cereals/Roots/Tubers
   * Pulses

* Fruits
* Milk Products
* Meat Products
* Eggs
* Artificial sweeteners

3. Foods to be avoided
   * Sugar
   * Sweets
   * Honey
   * Jam and Jellies
   * Cakes and pastries
   * Sweetened juices and soft drinks





In brief, the diabetics should

*avoid sweets
* use fats in limited amounts
* take cereals and pulses in right amounts
* include high fibre foods as much as possible
* take vegetables as desired
* take permitted fruits in limited amounts.

When diabetic patients have to eat in parties or restaurants, they should select food items from the menu based on these dietary guidelines.

Wrong beliefs

There is a common belief that diabetics can eat wheat but not rice. This is not true. Both wheat and rice have almost similar glycemic index and raise the blood sugar to a similar extent. Therefore, *it should not matter whether one takes wheat or rice, as long as the total quantity is restricted*. However, many diabetics feel it more convenient to count as well as to reduce the number of chapathis they eat than to measure the amount of rice they consume.

Total fasting is also not good for those who are on oral medicines or insulin as it may result in hypoglycemia. Similarly, the diabetic should not skip a meal on the assumption that it can be made up by consuming a little more at the next meal.

Earlier, there was a wrong notion that persons with diabetes, should restrict carbohydrates. It is now recognised that carbohydrates need not be restricted and that the normal Indian diet which provides 60-65% of calories from carbohydrates is right for diabetics. Diets containing high carbohydrates improve the action of insulin. The type of carbohydrates we eat has a direct bearing on the blood sugar level, rather than the amount of carbohydrates in the diet. Complex carbohydrates present in cereals and pulses are better for diabetics than sweets containing simple sugars.

Food Exchange System

The quantity of food and the total calorie intake of a diabetic should not vary markedly from day-to-day. For this purpose, a food exchange system is used in which foods providing almost the same amount of calories, carbohydrates, proteins or fats are grouped together. This helps in providing variety in the daily diet while keeping the total nutrient intake constant. For example, in a vegetable exchange, 50 g double beans or 90 g onion or 105 g of carrot provide 10 g carbohydrates and 50 calories. In the exchange system, although there may be differences in weights and size of the foods, all will provide the same amount of carbohydrates and energy.

Different groups of food exchanges are given in Appendix - 2. They are :

1. Vegetable exchange
2. Food exchange
3. Cereal exchange
4. Legume and pulse exchange
5. Flesh food exchange
6. Milk exchange
7. Fat exchange

Each exchange list provides a number of food items which can be interchanged within the group. It is realised that in a food exchange system, although different foods contain equal amount of carbohydrates, the extent of increase in postprandial (after-meal) blood glucose is not the same. Therefore, in recent years, instead of food exchanges, a glycemic index of foods is used. A rough estimate of the extent of rise in blood sugar with different foods can be made based on the glycemic index.

Glycemic index

Different carbohydrates raise the blood sugar to variable extents. It is therefore important to know, while recommending a diet for a diabetic, what is the extent of rise in blood sugar with different foods. The glycemic index indicates the extent of rise in blood sugar in response to a food in comparison with the response to an equivalent amount of glucose. The glycemic index is therefore useful in planning diets for diabetics.

Generally, cereals like wheat and rice and root vegetables such as potato, carrots have a high glycemic index (65-75%). Fruits have an intermediate glycemic index (45-55%). Legumes and lentils such as dried beans, peas, green gram and bengalgram have a low glycemic index (30-40%) and are beneficial to diabetics in moderate amounts. Bengal gram helps additionally in the prevention of atherosclerosis by reducing serum cholesterol and triglyceride levels. The glycemic index of various common Indian foods is given in Table 6.

One has to remember that though certain foods high in fat such as groundnuts, milk and ice cream have a low glycemic index, they are not good for diabetics. They have a high calorific value and excessive consumption of such foods is likely to increase the body weight leading to obesity. Similarly, fructose, in view of its effects on serun lipids, is not recommended. The glycemic response of different foods is influenced by the physical form, nature of cooking etc. For example, consumption of ground rice raises the blood sugar to a greater extent than of unground rice. Similarly, the glycemic response is higher with cooked than with raw food.

Diets with a lower glycemic index are generally rich in fibre. High carbohydrate and high fibre diets improve the glucose tolerance, and reduce diabetic symptoms and the dose of oral antidiabetic drugs required. Another approach to increase the fibre content is by addition of purified fibre supplements such as wheat bran, guargum, tragacanth, oat meal, ispaghul to the diets. Fenugreek seeds which also contain high fibre are useful to the diabetics in many ways.

HIGH CARBOHYDRATE AND HIGH FIBRE DIETS ARE BENEFICIAL IN THE CONTROL OF BLOOD SUGAR AND SERUM LIPIDS.

Model Diets

It is now recognised that a good control over blood sugar levels is essential for the prevention or postponement of long-term complications of diabetes. Since foods of low glycemic index and high fibre content raise the blood sugar to a lesser extent, diabetic diets have been planned on these two factors. However, the diabetic diet must be nutritionally adequate for the patient's requirements and it should be tailor-made for each individual patient based on age, sex, body weight and physical activity. Generally, lean diabetics are prescribed body weight-maintenance diets containing 1800 to 2000 Kcals while obese diabetics are given body weight-reducing diets providing 1200 to 1500 Kcals. Loss of body weight in obese diabetics improves effectiveness of insulin produced in the body.

OBESE DIABETICS SHOULD REDUCE BODY WEIGHT BY EXERCISE AND DIETARY MEANS

Table - 6
GLYCAEMIC INDEX OF COMMON FOODS

Item	Glycemic Index	Item	Glycemic Index
Cereal Products		**Fruits**	
Bread	70	Apple	39
Millets	71	Banana	69
Rice (White)	72	Orange	40
Wheat (Paratha)	70	**Vegetables**	
Breakfast snacks		Brown beans	79
Pongal	55	Frozen beans	51
Pesarattu	60	Potato	70
Upma	75	Sweet potato	48
Idli	80	Yam	51
Chole	65	Beetroot	64
Sprouted green gram	60	**Dried Legumes**	
Sundal	80	Soya beans	43
Dairy Products		Rajmah	29
Milk	33	Bengal gram	47
Ice-cream	36	Green gram	48
Curds	36	Black gram	48
Miscellaneous		**Sugars**	
Groundnuts	13	Fructose	20
Potato chips	51	Glucose	100
Tomato soup	38	Maltose	105
		Sucrose	59
		Honey	87

Source: Jenkins *et al.*, 1981; Am. J. Clin. Nutr., **34 :** 362, 1981.
Raghuram *et al.*, Diabetes Bull., **7 :** 64, 1987.
Dilwari *et al.*, Diet, Digestion & Diabetes, 1987.

For the guidance of diabetics, standard diets containing 1200, 1500 and 2000 Kcal along with food ingredients and nutritive value are given in Appendix 3 (Tables 18 to 25). The nutritive value of foods and common preparations and the approximate weights of common foods are given in the Appendix 4 (Tables 26 to 30). Common household measures are given in Appendix 5. This information is useful in the selection of raw materials and planning diabetic diets. Data on the approximate weight of common foods obviate the need for weighing each food item used in the preparation.

Dietary alterations in associated disorders

Frequently, diabetics are likely to have other disorders and the diet has to be altered accordingly. For example, dietary fat intake has to be limited in diabetics with high serum lipids or with heart disease. Similarly, protein intake in those with renal disease and salt intake in patients with hypertension and renal disease has to be restricted.

Alcohol

It is known that alcohol in excess is not good even for a normal person, although it is the most common drug of abuse. It may lower the blood sugar below certain critical normal limits and result in hypoglycemia.. Alcohol should never be taken with some antidiabetic drugs as it may make the diabetic very ill. Diabetics on continuous consumption of alcohol are likely to develop peripheral neuropathy. Alcohol provides empty calories as it doesn't contain proteins or fats. The extra calories may make a diabetic overweight or obese. Further, alcohol stimulates the appetite and dietary regulations are generally not complied with.

THE DIABETIC SHOULD AVOID ALCOHOL

When a diabetic cannot avoid alcohol, as at parties, he should only take a small quantity just before or along with food, provided his diabetes is under control.

Artificial sweeteners

Diabetics are advised to use artificial sweeteners in place of sugar. There are several artificial sweetening agents such as saccharin and aspartame ('Sugar Free') which are also calorie-free. Their limited use with beverages is normally considered safe for diabetics.

DIABETICS CAN USE ARTIFICIAL SWEETENERS INSTEAD OF SUGAR IN BEVERAGES

EXERCISE

Exercise improves the general well-being not only of normal but also of diabetic subjects. Exercise, when combined with reduced food intake, helps in reduction of body weight and other risk factors for heart disease. It also improves peripheral circulation. In addition, exercise enhances the action of insulin and thus helps to reduce the dose of antidiabetic drugs.

Persons with diabetes, should therefore exercise regularly. This can include brisk walking, jogging, bicycling, swimming, and playing badminton and tennis. It should become a part of daily routine. In addition, exercise is known to reduce stress and strain and enhance the quality of life. The pace and duration of exercise, however, can be decided depending on the age and physical fitness of the subject. Diabetic patients on insulin before engaging in strenuous exercise should seek medical advice to prevent hypoglycemia. They may require extra carbohydrates before, during and after the exercise.

REGULAR EXERCISE SHOULD BE AN INTEGRAL PART OF THE DAILY ROUTINE OF THE DIABETIC

DRUGS

In most patients with mild Type II diabetes, diet, exercise and weight-reduction, are enough to control high blood sugar. When the symptoms of diabetes persist, and blood sugar continues to be high, despite alterations in diet and exercise for 6-8 weeks, one has to depend on drugs as prescribed by the doctor. Depending on the type of diabetes, the doctor decides either on insulin injections or oral tablets in individual cases.

Insulin

Persons with Type I diabetes produce very little or no insulin and they, therefore, need insulin injections. Conventionally available insulins are prepared from bovine or porcine pancreas. In some individuals, conventional insulins may produce insulin resistance or allergy, or atropny or hypertrophy at the insulin injection site. Recently newer, highly purified semi-synthetic insulins have been developed by genetic engineering. Patients having adverse effects with conventional insulins can use much purified insulins.

The different types of insulin with their peak and duration of action are given in Table 7.

The doctor will decide the type of insulin that the diabetic requires. A person on insulin has to be more careful with the timing of his meals. The quantity of carbohydrate also should match the dose of insulin given. In addition to a regular schedule of breakfast, two meals and evening tea, patients with IDDM may require bedtime snacks to prevent hypoglycemia during the night. Patients with NIDDM also require insulin under certain circumstances, such as inadequate response to oral hypoglycemic drugs and during ketoacidosis, acute infections, surgery and pregnancy.

Oral Drugs

In NIDDM, the body produces insulin, but this may be less effective in controlling the high blood sugar levels. Anti-diabetic tablets, in such patients either enhance the production of insulin by the pancreas, or improve the action of the insulin produced in the body. There are two groups of drugs which are generally used in NIDDM, sulphonylureas and biguanides. Some common sulphonylureas are tolbutamide (Rastinon), chlorpropamide (Copamide, Diabinese), glibenclamide (Euglucon, Daonil, Betanase) and glipizide (Glynase). Important

Table - 7

PEAK AND DURATION OF ACTION OF VARIOUS INSULINS

Conventional Insulin	Peak action (hours)	Duration of action (hours)
Short acting		
Regular	2- 4	5- 7
Semilente	2- 8	12-16
Intermediate acting		
Isophane (NPH)	6-12	18-24
Lente	6-12	18-24
Long acting		
Ultralente	16-18	18-24
Protamine zinc	14-20	24-36

Source: Khandekar, S., Dash, R.J., Drug Bulletin, XI(3), 1988.

biguanides are metformin (Glyciphage) and phenformin (DBI). As the mode of action of these two groups of drugs is different, the doctor will decide the type of drug which is suitable to the particular person with diabetes. The duration of action and daily dose of oral drugs are given in Table 8.

Diabetics should not neglect diet control and exercise even if they are taking anti-diabetic tablets, as these measures improve the action of the drugs. Alcohol should not be consumed when the patient is taking certain anti-diabetic medicines.

A DIABETIC SHOULD TAKE DRUGS REGULARLY AS ADVISED BY THE DOCTOR

Table - 8

DURATION OF ACTION AND DAILY DOSE OF ORAL ANTIDIABETIC DRUGS

Name	Duration of action (hours)	Daily Dose (mg)
Tolbutamide	6-12	500 -3000
Glibenclamide	16-24	1.25 - 20
Glipezide	12-18	2.5 - 30
Chloropromide	60	100 - 500
Metformin	5	500 -3000
Phenformin	5	150 - 250

Source : Khandekar, S., Dash, R.J., Drug Bulletin, XI (3), 1988.

EDUCATION

The diabetics should be educated on the nature of the disease(s) they have and the possibility of development of acute and long term complications of the disease, if blood sugar is not kept under control. Adequate basic information on diabetes enables the diabetic to comprehend and improve their psychological acceptance of the disease. In addition, the importance of following the doctor's instructions regarding diet, exercise and drugs should be explained.

Diabetic should be aware of the importance of monitoring urine and blood sugar and serum lipids at regular intervals to ensure overall well-being. They should learn self-monitoring of urinary sugar, either using commercially available strips or the Benedict's test. Patients who require insulin injections should know how to measure the insulin dose and to give their own injections. Diabetics should be informed about the symptoms of hypoglycemia and the immediate need for taking sugar in such conditions. Similarly, they should be aware of the acute complications such as ketoacidosis and the danger of infections which require immediate medical attention. Diabetic patients should maintain a diary to keep a record of their urinary and blood sugar results, body weight and alterations in their diet and drugs.

EDUCATION OF THE PATIENT IS AN INTEGRAL AND IMPORTANT COMPONENT IN THE MANAGEMENT OF DIABETES

During illness

When diabetics fall sick, they should be careful with their activities, diet and drugs. Exercise should be avoided and rest should be taken. If usual meals cannot be eaten, at least enough liquid diet at frequent intervals should be taken. Urine or blood should be tested more often and the doses of antidiabetic drugs prescribed by the doctor should be taken. During infections or other acute complications, a changeover to insulin may be required and the doctor should be consulted.

DURING ILLNESS ONE SHOULD TAKE REST, ADEQUATE DIET AND THE DRUGS PRESCRIBED

APPENDIX - 1
FENUGREEK RECIPES

1. Adai

Ingredients	Weight (g)	Measure
Rice	30	2 tbsp
Blackgram dhal	15	3 tsp
Redgram dhal	15	3 tsp
Greengram dhal	15	3 tsp
Fenugreek seeds	12.5	2 tsp
Oil	15	3.3/4 tsp
Salt	to taste	

Method

Soak rice, dhals and fenugreek seeds overnight. In the morning grind them coarsely. Add all the spices. Spread ladleful of batter on a hot greased tawa (iron pan). Fry on slow fire on both sides. Cook the entire mixture this way.

No. of adai : Three

2. Chapathi

Ingredients	Weight (g)	Measure
Wheat flour	90	1 K
Fenugreek seed powder	12.5	2 tsp
Salt	to taste	

Note: K - Katori of capacity 150 ml.

Method

Soak fenugreek seeds overnight. Throw away the water, dry the seeds and powder them. Add this powder to wheat flour and make the dough. Divide into four balls and roll them into chapathis. Put one by one on hot tawa and let it remain for a few seconds, till brown marks appear, turn and pat with a piece of cloth to puff.

No. of chapathis : Four

DLS 36
04791
COMMUNITY HEALTH CELL
LIBRARY
AND
DOCUMENTATION
UNIT

3. Dalia

Ingredients	Weight (g)	Measure
Broken wheat	60	1/3 K
Greengram dhal	30	1/4 K
Fenugreek seeds	12.5	2 tsp
Cumin	1	a pinch
Oil	5	1-1/4 tsp
Black pepper	1	a pinch
Water	250 ml	1-2/3 K
Salt	to taste	

Method

Soak fenugreek seeds overnight. In the morning, heat oil; fry wheat and green gram dhal till golden brown. Add fenugreek seeds and water and cook till soft and semi-solid. Add salt and serve hot.

Measure: 2.3/4 K.

4. Dhokla

Ingredients	Weight (g)	Measure
Besan*	60	3/4 K
Curd	100	2/3 K
Fenugreek seeds	12.5	2 tsp
Oil	5	1-1/4 tsp
Salt	to taste	

* Bengalgram dhal powder

Method

Soak fenugreek seeds overnight. Throw away the water, dry the seeds and grind them to a fine powder. To this powder add salt, turmeric and besan. Make a batter with the help of curd and water. Keep it aside to ferment for 5-6 hours depending upon the weather. After adding a pinch of soda-bicarb, mix well and pour into a greased dish. Sprinkle some red chillie powder over it. Steam the whole till set. Cool for a few seconds; cut into small pieces and season with mustard seeds, red chillies and coriander leaves.

No. of dhoklas : Ten

5. Dosai

Ingredients	Weight (g)	Measure
Rice	70	1/2 K
Blackgram dhal	10	2 tsp
Fenugreek seeds	12.5	2 tsp
Oil	15	3-3/4 tsp
Salt	to taste	

Method

Soak fenugreek seeds along with dhal, and rice separately. In the morning, grind both items separately till they become very smooth. Mix and add salt. Keep for 5-6 hours to ferment. Heat a tawa and smear with oil. Pour a ladleful of the mixture, spread evenly and fry from both sides, using a little oil. Cook the entire mixture this way.

No. of dosais : Five

6. Idli

Ingredients	Weight (g)	Measure
Rice	60	1/2 K
Blackgram dhal	30	1/4 K
Fenugreek seeds	12.5	2 tsp
Salt	to taste	

Method

Soak dhal and fenugreek seeds together and rice separately for 5-6 hours. Grind rice (coarse) and dhal (very smooth and fine), mix both, add salt and thoroughly mix again. Keep mixture overnight for fermentation. Next day steam small portions (four) of the mixture in an idli mould till set and cooked.

No. of idlis : Four

7. Paratha

Ingredients	Weight (g)	Measure
Atta	60	2/3 K
Besan	30	1/3 K
Oil	10	2-1/2 tsp
Fenugreek seeds	12.5	2 tsp
Salt	to taste	

Method

Soak fenugreek seeds overnight, throw away the water, dry the seeds and powder them. Add this powder to the wheat flour. Add besan, salt and make dough. Divide into three balls and roll them into chapathis. Apply a little oil and fold into a triangle and roll this again into chapathi. Place on hot tawa and wait till slightly dry. Turn and wait till brown marks appear. Apply some oil (about 1 teaspoon), turn and fry from both sides.

No. of parathas : Three

8. Pesarattu

Ingredients	Weight (g)	Measure
Greengram whole	60	1/2 K
Rice	30	2 tbsp
Fenugreek seeds	12.5	2 tsp
Oil	10	2-1/2 tsp
Salt	to taste	

Method

Soak dhal and fenugreek seeds overnight. In the morning grind and mix all the ingredients except oil. Heat tawa and smear with oil. Spread ladleful of mixture evenly and fry both sides with one teaspoonful of oil. Cook the entire mixture this way.

No. of pesarattu : Three

9. Pongal

Ingredients	Weight (g)	Measure
Rice	60	1/2 K
Lentil dhal	30	1/4 K
Fenugreek seeds	12.5	2 tsp
Oil	5	1-1/4 tsp
Cumin	1	a pinch
Black pepper	1	a pinch
Water	200 ml	1-1/3 K
Salt	to taste	

Method

Soak fenugreek seeds overnight. In the morning throw away the water and cook them along with rice and dhal till the grains are soft. Add salt and pepper. Season with oil and cumin.

Quantity : 1.1/2 Katori.

10. Ragi idli

Ingredients	Weight (g)	Measure
Ragi	60	1/2 K
Blackgram dhal	30	1/4 K
Fenugreek seeds	12.5	2 tsp
Salt	to taste	

Method

Clean ragi properly and soak overnight. Soak dal and fenugreek seeds overnight. In the morning, grind both of them separately and then mix. Add salt and keep for 5-6 hours for fermentation. Then steam small portions (4) of the mixture in an idli mould till set and cooked.

No. of Ragi Idlis : Four

11. Ragi Roti

Ingredients	Weight (g)	Measure
Ragi (dried and powdered)	90	3/4 K
Onion	20	1/2 (medium)
Green chillies	5	Five
Oil	5	1-1/4 tsp
Fenugreek seeds	12.5	2 tsp
Salt	to taste	

Method

Soak fenugreek seeds overnight. Throw away the water. Dry the seeds and powder them. Chop onions and green chillies. Mix everything together and make into dough. Divide in three portions. Keep a paper on rolling board and apply a little water to it. Put one dough ball and with moist hand, press it into a chapathi. Heat a tawa and smear with oil. Place the roti over it and remove the paper. Let it get cooked for a few seconds, apply oil, turn the side and fry the other side too. Cook rest of the roties in the same way.

No. of ragi rotis : Three

12. Rava Dosai

Ingredients	Weight (g)	Measure
Bombay rava	60	1/2 K
Maida/Rice powder	20	1/4 K
Green chillies	5	Five
Onion	20	1/2 medium
Green coriander	2	3/4 bundle (small)
Curry leaves	2	few
Oil	15	3-3/4 tsp
Fenugreek seeds	12.5	2 tsp
Curd	100	2/3 K
Salt	to taste	

Method

Soak fenugreek seeds overnight. Throw away the water, dry the seeds and powder them. Chop green chillies, onions, curry leaves, ginger and along with salt, add to rava mixture. Make a batter using curd and water. Smear hot tawa with a little oil. Spread a ladleful of this mixture and fry from both sides. Cook the whole mixture in this way.

No. of rava dosai : Three

13. Vegetable Omlette

Ingredients	Weight (g)	Measure
Besan	60	3/4 K
Onion	20	1/2 medium
Green chillies	5	Five
Mustard	0.5	a pinch
Fenugreek seeds	12.5	2 tsp
Oil	10	2-1/2 tsp
Tomato	30	One
Salt	to taste	
Water	60 ml	1/3 K

Method

Soak fenugreek seeds overnight. Throw away the water, dry the seeds and powder them. Chop onions, green chillies and tomatoes. Mix all the ingredients except oil and make into a batter with the addition of water. Spread one ladleful of the mixture on a greased hot tawa and fry from both sides with one teaspoonful of oil. Cook the whole mixture in this manner.

No. of vegetable omlettes : Three

14. Upma

Ingredients	Weight (g)	Measure
Suji (Rava)	60	1/2 K
Onion	20	1/2 (medium)
Green chillies	5	Five
Mustard	0.5	a pinch
Blackgram dhal	3	1/2 tsp
Bengalgram dhal	3	1/2 tsp
Oil	10	2-1/2 tsp
Fenugreek seeds	12.5	2 tsp
Water	200 ml	1-1/3 K

Method

Soak fenugreek seeds overnight. Throw away the water, dry the seeds and powder them. Chop green chillies and onions. Splutter mustard in hot oil, add black and bengalgram dhals. Fry them for a few seconds. Add chopped onion and green chillies and fry till the onions become slightly brown. Add rava and fenugreek powder. Fry for about a minute. Add salt and water. Cook on slow fire till done.

Measure : 1.3/4 K.

Table - 9

NUTRITIVE VALUE OF COOKED FENUGREEK RECIPES

Preparation	Weight (g)	Calories (Kcal)	Proteins (g)	Fats (g)	Carbo-hydrates (g)
Adai	245	435	15	17	56
Chapathi	140	350	14	2	68
Dalia	400	400	18	7	67
Dhokla	150	370	19	13	44
Dosai	220	455	10	16	66
Idli	220	355	15	2	70
Paratha	130	450	17	13	65
Pesarattu	220	435	20	12	63
Pongal	310	405	15	7	71
Ragi Idli	200	345	15	2	67
Ragi roti	150	450	11	8	73
Rava dosai	300	530	15	20	72
Veg. omlette	140	390	18	15	45
Upma	250	390	13	12	58

APPENDIX - 2

FOOD EXCHANGE LIST

Table - 10

VEGETABLE EXCHANGE A*

Leafy Vegetables	Other Vegetables
Amaranth	Ash gourd
Bathua	Bitter gourd
Brussels sprouts	Brinjal
Cabbage	Calabash cucumber
Celery	Cauliflower
Coriander leaves	Cho-cho (Mamko)
Curry leaves	Cucumber
Fenugreek leaves	Drumstick
Lettuce	French beans
Mint	Knol-khol
Rape leaves	Lady's fingers
Spinach	Mango, green
Soya leaves	Onion stalks
	Parwal
	Plantain flower
	Pumpkin
	Radish
	Rhubarb stalks
	Snake gourd
	Tinda
	Tomato, green
	Turnip

* Carbohydrate and calorie content of these vegetables are negligible and they may be used in any quantity.

Table - 11
VEGETABLE EXCHANGE - B

Carbohydrates - 10 g — 50 Calories

	Quantity (g)
Root Vegetables	
Beetroot	75
Carrot	105
Colocasia	45
Onion (big)	90
Onion (small)	75
Potato	45
Sweet potato	30
Tapioca	30
Yam (elephant)	60
Yam	45
Other Vegetables	
Artichoke	60
Broad beans	90
Cluster beans	90
Double beans	50
Jack, tender	105
Jackfruit seeds	30
Peas	45
Plantain, green	75
Singhara	45

Table - 12
FRUIT EXCHANGE

Carbohydrates - 10 g 50 Calories

Fruit	Quantity (g)	Number or size
Amla	90	20 medium
Apple	75	1 small
Banana	30	1/4 medium
Cape gooseberry (rasbari)	150	40 small
Cashew fruit	90	2 medium
Custard apple (Sitaphal)	50	1/4
Dates	30	3
Figs	135	6 medium
Grapes	105	20
Grape fruit	150	1/2 big
Guava	100	1 medium
Jackfruit	60	3 medium pieces
Jambu fruit	50	10 big
Lemon or lime	90	1 medium
Loquat	105	6 big
Mango	70	1 small
Melon	270	1/4 medium
Orange (Santhra)	90	1 small
Papaya	120	2 medium
Peach	135	1 medium
Pear	90	1 medium
Pineapple	90	1-1/2 slices (round)
Plum	120	4 medium
Pomegranate	75	1 small
Sapota	50	One
Strawberry	105	40
Sweet lime (mosambi)	150	1 medium
Tomato	240	4 medium
Watermelon	175	1/4 small

Table - 13

CEREAL EXCHANGE

30 g. provide 100 calories.

Carbohydrates : 20 g Protein : 2 g

Bajra	Rice flakes
Barley	Rice puffed
Bread*	Sago**
Jowar	Samai
Corn flakes	Semolina (Suji)
Maize, dry	Vermicelli (Savian)
Oatmeal	Wheat flour
Ragi	Wheat, broken (dalia)
Rice	White flour

* To meet carbohydrates and calories add 5 g. sugar.

** Requires supplementation with other high protein foods, when used. Within this list, one food item can be exchanged with another item.

Table - 14

LEGUME AND PULSE EXCHANGE

30 g provide 100 calories

Carbohydrates : 15 g Protein : 6 g

Bengal gram	Kabuli channa (White gram)
Bengal gram, roasted	Lentil
Besan (Bengal gram flour)	Moth beans
Black gram	Peas, dried
Cow gram (lobia)	Rajmah
Green gram	Red gram
Horse gram	

Within this list, one food item can be exchanged with another, but not with cereal exchange list.

Table - 15

FLESH FOOD EXCHANGE

Protein 10 g 70 Calories

Food	Quantity (g)
Beef	60
Crab	120 Nos.
Egg, duck*	2 Nos.
Egg, hen*	2 Nos.
Fish, big	60
Fish, small	60
Fowl	60
Liver, sheep	60
Mutton muscle*	60
Pigeon	50
Pork	60
Prawn	60

* Provides 100 calories.

Some flesh foods contain excess fat, visible fat and skin of poultry should be removed.

Table - 16

MILK EXCHANGE

Protein - 5 g 100 Calories

Food	Quantity
Buttermilk	750 ml
Cheese	30 g
Curd	210 g
Khoa	30 g
Buffalo milk	90 ml
Cow milk	180 ml
Skimmed milk*	260 ml
Skimmed milk powder*	30 g

* Provides 10 g. protein.

Table - 17

FAT EXCHANGE

Fat - 11 g 100 Calories

Food	Quantity (g)
Almonds	15
Butter	15
Cashewnuts	20
Coconut	30
Ghee	11
Groundnuts roasted	20
Hydrogenated fat (vanaspati)	11
Oil (groundnut, mustard)	11
Pistachionut	15
Walnuts	15

Any one food item in the list can be exchanged with another,but it should not be exchanged with any other exchange list.

APPENDIX - 3

DIABETIC DIETS

Table - 18

1200 CAL. DIABETIC DIET

Foodstuff	Amount (g)	
	Vegetarian	**Non-Ve getarian**
Cereals	150	185
Pulses	60	15
Green leafy vegetables	200	200
Other vegetables	200	200
Fruits	100	100
Milk	300	100
Oil	10	15
Flesh foods	---	50
This diet provides :	g.	% Calories
Proteins	50	16
Fats	29	21
Carbohydrates	190	63

Table - 19

SAMPLE MENU

	Cooked Food	
	Vegetarian	**Non-Vegetarian**
Bed Tea		
Tea/Coffee	1 cup	1 cup
Breakfast		
Toast	One	Two
Milk	1 cup	---
Tea/Coffee	---	1 cup
Orange	One	One
Lunch		
Rice	1 K	1 K
Sambar*	1 K	1 K
Amaranth	1 K	1 K
Buttermilk	1 K	1/2 K
Tomato	One	One
Cucumber	One	One
Evening		
Tea/Coffee	1 cup	1 cup
Upma	1/2 K	1/2 K
Dinner		
Phulka*	Three	Four
Lentil dhal	3/4 K	---
Beans curry	1 K	1 K
Egg curry	---	1 K
Buttermilk	1 K	---
Tomato	One	One
Radish	One	One
Note: Oil to cook	3 tsp	4 tsp.

* With fenugreek seeds 12.5 g

Table - 20

1500 CAL. DIABETIC DIET

Foodstuff	Amount (g) Vegetarian	Non-vegetarian
Cereals	225	250
Pulses	60	20
Green leafy vegetables	200	200
Other vegetables	200	200
Fruits	100	100
Milk	300	150
Oil	15	20
Flesh foods	---	70
This diet provides :	g	% Calories
Proteins	60	15.5
Fats	37	21.5
Carbohydrates	244	63.0

Table - 21

SAMPLE MENU

	Cooked Food	
	Vegetarian	**Non-vegetarian**
Bed Tea		
Tea/Coffee	1 cup	1 cup
Breakfast		
Toast	Two	Two
Egg (half boiled)	---	One
Milk	1 cup	---
Tea/Coffee	---	1 cup
Orange	One	One
Lunch		
Rice	2 K	2 K
Phulka	One	One
Sambar*	1 K	1 K
Spinach	1 K	1 K
Curd	1/2 K	1/4 K
Tomato/Cucumber	One	One
Pickle	1 piece	1 piece
Evening		
Tea/Coffee	1 cup	1 cup
Upma	3/4 K	3/4 K
Dinner		
Phulka (Chapati)*	Three	Four
Green gram dhal	1 K	---
Cauliflower curry	1 K	1 K
Fish/Chicken curry	---	2 pieces
Roasted papad	One	One
Tomato/Cucumber	One	One
Before going to bed		
Milk	1 cup	1/2 cup
Note: Oil to cook	4 tsp	5 tsp.

* With 12.5 g fenugreek seeds.

Table - 22

2000 CAL. DIABETIC DIET

Foodstuff	Amount (g)	
	Vegetarian	Non-Vegetarian
Cereals	300	350
Pulses	70	25
Green leafy vegetables	200	200
Other vegetables	200	200
Fruits	200	200
Milk	400	200
Oil	20	25
Flesh foods	---	30
This diet provides :	g	% Calories
Proteins	64	13
Fats	48	22
Carbohydrates	328	65

Table - 23

SAMPLE MENU

	Cooked Food	
	Vegetarian	**Non-vegetarian**
Bed Tea		
Tea/Coffee	1 cup	1 cup
Breakfast		
Toast	Three	Four
Milk	1 cup	---
Egg (boiled)	---	One
Orange	One	One
Lunch		
Rice	2 K	2 K
Phulka	One	One
Sambar*	1 K	1 K
Cabbage	1/2 K	1/2 K
Buttermilk	1 K	1/2 K
Tomato	One	One
Cucumber	One	One
Evening		
Tea/Coffee	1 Cup	1 Cup
Tomato sandwich	Two	Two
Dinner		
Pulka (Chapati*)	Two	Three
Rice	1/2 K	1/2 K
Moth	1 K	---
Dondakai curry	1 K	1 K
Chicken roasted	---	1 piece
Curd	1 K	---
Cabbage salad	2 tbsp	2 tbsp
Onion (medium)	One	One
Note: Oil to cook	5 tsp	6 tsp

* With 12.5 g fenugreek seeds.

DLS-Box
04791
COMMUNITY HEALTH CELL
LIBRARY
AND
DOCUMENTATION
UNIT

Table - 24

DIABETIC DIET FOR CHILDREN

Foodstuff	(Amount g) Vegetarian	Non-Vegetarian
Cereals	375	425
Pulses	60	20
Green leafy vegetables	200	200
Other vegetables	200	200
Fruits	200	200
Milk	300	150
Oil	25	30
Flesh foods	---	50
This diet provides :		% Calories
Calories (Kcal)	2265	
Proteins	75 g	13.3
Fats	60 g	23.8
Carbohydrates	356 g	62.9

Table - 25

SAMPLE MENU

	Cooked Food	
	Vegetarian	**Non-Vegetarian**
Early morning		
Milk	1 cup	1 cup
Breakfast		
Toast	3	4
Butter	3/4 tsp	1 tsp
Milk	1 cup	--
Egg	--	One
Orange	One	One
Lunch		
Rice	1 K	1 K
Phulka	Three	Three
Sambar*		
Seeds	1 K	1 K
Fenugreek leaves	1/2 K	1/2 K
Buttermilk	1 K	1/2 K
Tomato	One	One
Radish	One	One
Evening		
Tea	1 cup	1 cup
Cucumber sandwich	Two	Two
Dinner		
Phulka*	Three	Four
Rice	1/2 K	1/2 K
Bengalgram dhal	1 K	-- -
Brinjal curry	1 K	1 K
Fish curry	--	1/2 K
Curd	1 K	- -
Lettuce leaves/cabbage	Two	Two
Tomato	One	One
Note: Oil to cook	5 tsp	6 tsp

* With 12.5 g fenugreek seeds.

APPENDIX - 4

Table - 26

AVERAGE NUTRITIVE VALUE OF FOODS PER 100 G

Foodstuffs	Proteins (g)	Fats (g)	Carbohydrates (g)	Calories (Kcal)
Cereal	9.9	2.3	71.0	344
Bread	7.8	0.7	51.9	245
Salt biscuit	6.6	32.4	54.6	534
Sweet biscuit	6.4	15.2	71.9	450
Pulses	22.6	2.0	58.4	342
Green leafy vegetables	3.8	0.6	6.0	45
Roots and Tubers	1.2	0.2	16.0	70
Other vegetables	2.2	0.3	6.3	36
Nuts and Oilseeds	15.2	46.6	20.4	578
Condiments & Spices	9.8	6.6	40.6	261
Fruits	1.1	0.4	7.6	79
Meat	21.0	4.9	0.8	131
Egg	13.3	13.3	--	173
Milk	3.6	5.8	4.7	85
Curd	3.1	4.0	3.0	60
Butter	--	81.0	--	729
Ghee	--	100.0	--	900
Oil	--	100.0	--	900
Sugar	0.1	--	99.4	398
Honey	0.3	--	79.5	319
Jaggery	0.4	0.1	95.0	383
Sago	0.2	0.2	87.1	351

Source : S. Pasricha, Count What You Eat, NIN, Hyderabad, 1989.

Table - 27
NUTRITIVE VALUE OF COOKED PREPARATIONS

Preparation	Cooked					
	Weight (g.)	Measure	Calories (Kcal)	Proteins (g)	Fats (g)	Carbo hydrates (g)
Cereals						
Rice	100	1 K	110	2	—	25
Kicheri	100	1 K	215	4	7	33
Pulao	150	1 K	180	5	5	29
Paratha	50	One	180	4	4	24
Phulka	35	One	85	3	—	18
Puri	25	One	80	2	3	12
Pulses						
Dhal (broken)	140	1 K	160	10	4	25
Whole gram	120	1 K	125	7	5	14
Vegetables						
Kootu	155	1 K	145	5	8	15
Spinach with dhal	140	1 K	115	6	5	12
Samber	160	1 K	80	4	2	12
Green leafy vegetables	100	1 K	130	2	10	7
Potato with gravy	135	1 K	130	2	2	17
Other vegetable curry	130	1 K	150	3	10	12
Other vegetable dry	120	1 K	115	2	7	10
Potato with other vegetables	100	1 K	120	2	6	12
Snacks						
Pohe	100	1 K	200	2	9	30
Bajji	60	Eight	280	4	22	17
Veg. Omlette	100	One	220	7	12	22
Dahi vada	165	Two	345	11	19	31
Vada	45	Two	140	6	6	15
Masala vada	60	Three	170	6	7	20
Dosa	85	Two	255	6	7	42
Idli	115	Two	155	5	—	35
Samosa	65	One	210	3	13	21
Sandwich	65	Two	195	3	14	14
Savian upma	80	1 K	130	3	4	21
Upma	130	1 K	210	5	9	26

Table - 27 (contd.)

Preparation	Cooked					
	Weight (g)	Measure	Calories (Kcal)	Proteins (g)	Fats (g)	Carbo-hydrates (g)
Chutneys						
Coconut chutney	55	2 tbsp	125	2	10	6
Coriander chutney	20	1 tbsp	45	1	4	2
Groundnut chutney	20	1 tbsp	65	3	5	3
Mint chutney	18	1 tbsp	7	–	–	2
Tomato chutney	50	1/2 K	32	1	1	5
Non-Vegetarian						
Dam ka chicken	125	1 K	260	26	15	4
Fish cutlet	80	Two	190	14	9	12
Fish fried	85	Two	220	18	12	6
Fish jhol	110	1 K	140	18	3	12
Liver do-pyaza	140	1 K	330	22	22	11
Mutton ball curry	145	1 K	240	10	18	10
Prawn curry	145	1 K	220	18	7	22

Source : S. Pasricha, Count What You Eat, NIN, Hyderabad, 1989.

Table - 28

APPROXIMATE WEIGHT OF FOODS EQUAL TO 1 LEVEL KATORI (BOWL) OF 150 ml VOLUME

Item	Weight/1 K (g)
Cereals	
Rice	150
Rice flour	90
Semolina	120
Wheat flour	90
White flour (maida)	80
Pulses	
Bengal gram dhal	130
Bengal gram dhal flour	80
Black gram dhal	130
Green gram dhal	140
Lentil dhal	130
Red gram dhal	140
Whole Pulses and Legumes	
Black-eye beans	130
Green gram whole	140
Kabuli channa	130
Kidney beans	120
Lentil whole	125

Source : S. Pasricha, Count What You Eat, NIN, Hyderabad, 1989.

Table - 29
AVERAGE WEIGHT OF VEGETABLES

Vegetable	Weight per piece g
Ash gourd	1000
Beans, French	3
Brinjal (small)	20
Brinjal (long)	50
Brinjal (big)	250
Cabbage	500
Capsicum	30
Carrot	40
Cauliflower	200
Dondakai	10
Drumstick	30
Fenugreek leaves (bundle)	12
Lady's finger	10
Onion (medium)	50
Pumpkin	1100
Radish	150
Raw banana	60
Ridge gourd	50
Spinach (bundle)	20
Tomato	40

Source : S. Pasricha, Count What You Eat, NIN, Hyderabad, 1989.

Table - 30
AVERAGE WEIGHT OF NUTS AND SPICES

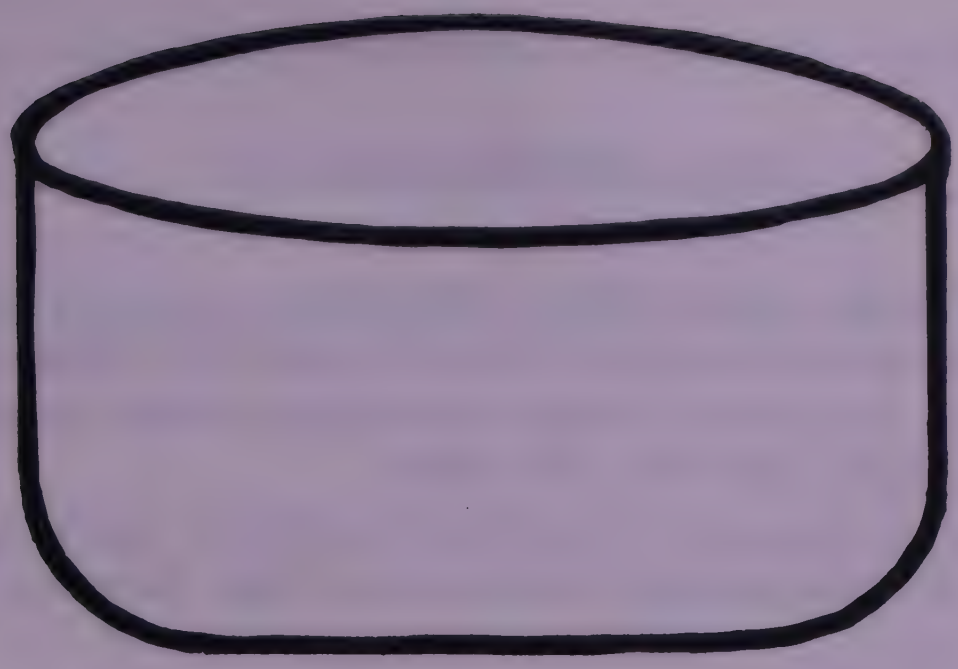
Nuts	Measure/ Number	Weight g
Almonds (small)	Fifteen	20
Cashewnuts	Fifteen	25
Coconut, dry	One	160
Coconut, fresh	One	150
Groundnuts	Twenty	6
Poppy seeds	1 tsp	4
Raisins	Fifteen	5
Sesame seeds	1 tsp	3
Spices		
Asafoetida	1 tsp	6
Black pepper	1 tsp	5
Cardamom	Ten	1
Chilli powder	1 tsp	7
Cinnamon	1 piece	0.5
Cloves	Twelve	1
Coriander leaves	1 bundle	3
Coriander powder	1 tsp	7
Curry leaves	1 bundle	5
Cumin	1 tsp	5
Fenugreek seeds	1 tsp	6
Garlic	1 pod	0.5
Green chillies	Five	5
Mint	1 bundle	5
Mustard seeds	1 tsp	10
Salt	1 tsp	10
Sugar	1 tsp	7
Turmeric	1 tsp	8

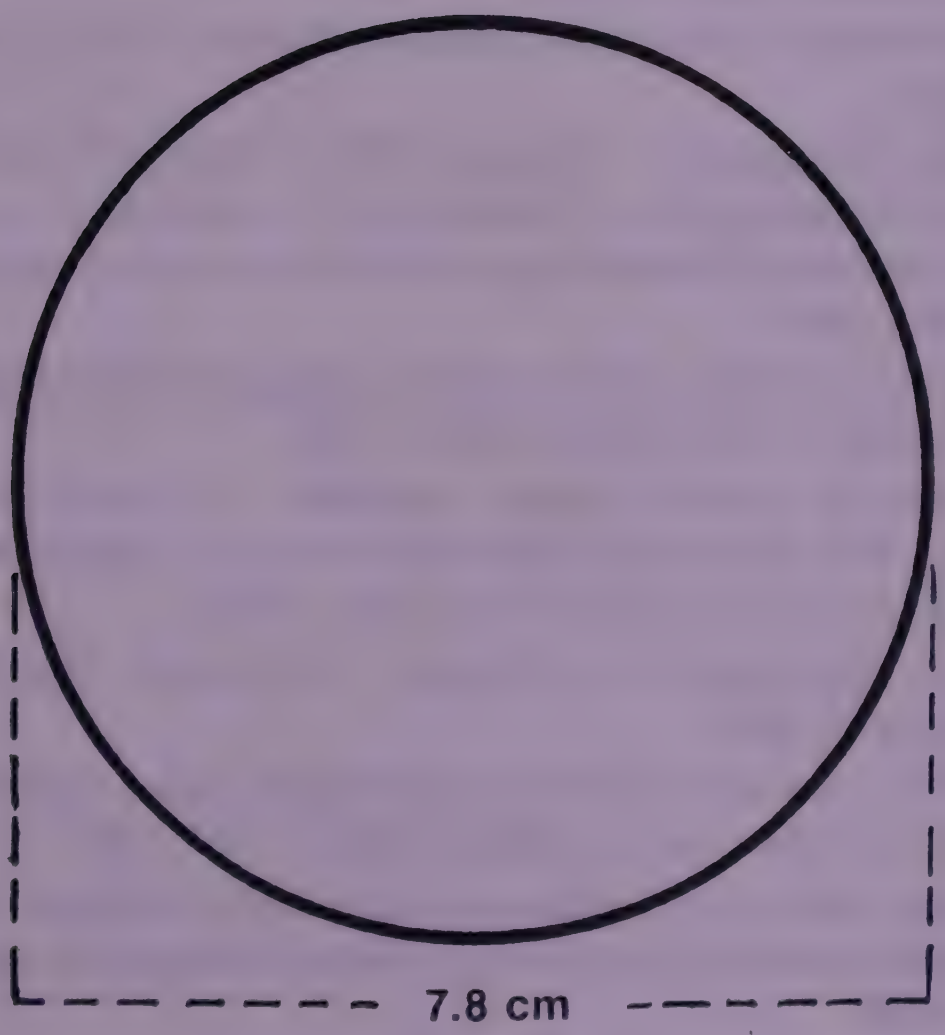
Note: Teaspoonful is always heaped.
tsp : tea spoonful.

TABLESPOON (15 ml)

TEASPOON (5 ml)

ACTUAL SIZES OF SPOONS





ACTUAL SIZE OF KATORI

BIBLIOGRAPHY

FOR FURTHER READING

1. American Diabetes Association. Principles of nutrition and dietary recommendations for individuals with diabetes mellitus. Diabetes, 28:1027, 1979.

2. British Diabetic Association. Dietary recommendations for diabetics in the 1980s. Hum. Nutr. Appl. Nutr. 36A : 378, 1982.

3. Diet, Digestion and Diabetes. Ed. by Kizarahamath, B., Madanagopalan, N. and Prathap Kumar, S. First National Workshop on Diet, Digestion and Diabetes, Madras, 1987.

4. Dilawari, J.B., Ajit Kumar, Bhattacharya, Arora. Glycaemic response of commonly consumed foods in India. First National Workshop Manual on Diet, Digestion and Diabetes, Madras, 1987, p.257.

5. Krall, L.P. and Beaser, R.S. Joslin Diabetes Manual. 12th Ed. Lea and Febiger, Philadelphia, 1989.

6. Jenkins, D.J.A., Thomas, D.M., Wolever, M.S., Taylor, R.H., Barker, H., Fielden, H., Baldwin, J.M., Bowling, A.C., Newman, H.C., Jenkings, A.L. and Croff, D.V. Glycaemic index of foods : A physiological basis for carbohydrate exchange. Am. J. Clin. Nutr. 34 : 362, 1981.

7. Narasinga Rao, B.S. Dietary Fibre in Indian Diets and its Nutritional Significance. Nutrition Foundation of India Bulletin, 9(4), 1988.

8. Nutritive Value of Indian Foods. Gopalan, C., Rama Sastry, B.V. and Balasubramanian, S.C. Revised by Narasinga Rao, B.S., Deosthale, Y.G. and Pant, K.C., National Institute of Nutrition, Hyderabad, 1990.

9. Powers, A.N. Handbook of Diabetes Nutritional Management. Aspen Publication, Maryland, 1987.

10. Raghuram, T.C., Swaran Pasricha, Upadhyaya, A.C., and Krishnaswamy, K. Glycaemic index of Indian foods. Diabetes Bull. 7 : 64, 1987.

11. Report of the National Cholesterol Education Program. Expert Panel on detection, evaluation and treatment of high blood cholesterol in adults. Arch. Intern Med. 148 : 36, 1988.

12. Sharma, R.D., Effect of fenugreek seeds and leaves on blood glucose and serum insulin responses in human subjects. Nutr. Res. 6 : 1353, 1986.

13. Sharma, R.D. and Raghuram, T.C. Hypoglycaemic effect of fenugreek seeds in non-insulin dependent diabetic subjects. Nutr. Res. 10 : 701, 1990.

14. Sharma, R.D., Raghuram, T.C. and Sudhakar Rao, N. Effect of fenugreek on blood glucose and serum lipids in Type I diabetes. Eur. J. Clin. Nutr. 44 : 301, 1990.

15. Swaran Pasricha. Some Therapeutic Diets. National Institute of Nutrition, Hyderabad, 1990.

16. Swaran Pasricha. Count What You Eat. National Institute of Nutrition, Hyderabad, 1989.

17. Vinik, A.I., and Wing. R.R. The good, the bad,and the ugly in diabetic diets. Endocrinol. Metabolism, Clin. North. Am. 21 : 237, 1992.

18. World Health Organization. Diabetes Mellitus. WHO Tech. Rep. Ser. No.727, 1985.